AQA A2 Physics Worksheet

Astrophysics - Classification of stars | A2 Level | Spec Ref: 3.10.1.2

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Student Name: _____ Date: _____ Total: 55 marks

1. **[1 mark]**

Define the term 'main sequence star'.

2. **[2 marks]**

State two physical properties of a star that determine its position on the Hertzsprung-Russell (HR) diagram.

3. **[3 marks]**

Explain why the temperature of a red giant star is lower than that of a main sequence star of similar luminosity.

4. **[4 marks]**

A star has a surface temperature of 5800 K and a luminosity of 3.8×10^{26} W. Calculate the radius of this star. Assume the Stefan-Boltzmann constant $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}.

5. **[5 marks]**

Describe the main characteristics of a white dwarf star, including its typical size, density, and energy source.

6. **[7 marks]**

The table below shows some properties of four stars, P, Q, R, and S.

6. **[7 marks]**

Star	Surface Temperature (K)	Luminosity ($L_\odot$)
P	3500	10^4
Q	10000	10^2
R	5000	10^{-2}
S	25000	10^5

a) Plot these stars on a sketch Hertzsprung-Russell (HR) diagram. Label the axes and indicate the positions of the main sequence, red giants, and white dwarfs.
b) Classify each star (P, Q, R, S) based on its position on your HR diagram.

7. **[4 marks]**

Explain the significance of the spectral classification system (OBAFGKM) for stars.

8. **[3 marks]**

A star has a peak emission wavelength of 290 nm. Calculate its surface temperature. Wien's displacement constant $b = 2.90 \times 10^{-3}$ m K.

9. **[5 marks]**

Compare and contrast the evolutionary paths of a low-mass star (like the Sun) and a high-mass star (e.g., 10 $M_{\odot}$) after they leave the main sequence.

10. **[6 marks]**

A star has a surface temperature of 4000 K and a radius 100 times that of the Sun ($R_{\odot} = 6.96 \times 10^8$ m). The Sun's surface temperature is 5800 K.

a) Calculate the luminosity of this star in terms of the Sun's luminosity ($L_{\odot}$).

b) Based on your answer to part (a) and the given temperature, classify this star.

11. **[8 marks]**

Discuss the physical processes that lead to the formation of a neutron star and a black hole. Explain the conditions under which each of these stellar remnants forms, and describe their key properties.

Total marks: _____ / 55